

SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE SOUTHPORT MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

It is just twenty years since the British Association first met at Southport, a comparatively short interval between two successive visits of this peripatetic body to one place. Although Southport in 1883 was a much smaller place than it is now, it was yet able to accommodate in addition to its crowd of summer visitors 2,710 members and associates of the British Association. Since then Southport has considerably extended its bounds and greatly increased its accommodation for holiday-makers, so that if the attendance at the meeting which begins on September 9 be increased in proportion, the second Southport meeting ought to reach the *maximum*. The previous one was above the average, and after all, it is doubtful whether it will be much exceeded on the present occasion. And yet Southport itself has many more summer attractions than the great cities which form the usual places of meeting of the association. Its fine sands, its esplanade and its numerous other open-air attractions may tend, should the weather be favorable, to diminish the attendance at the sectional meetings, especially among that considerable body who, without disrespect, may be called the camp followers

* From the *London Times*.

of the army of science—a section which at the same time performs a most useful function, as without such a body the receipts at the previous meeting would not have amounted to the considerable sum of £3,369, enabling the association to allot grants for scientific investigation amounting to £1,083. What may be called the outside attractions of the second Southport meeting will be many. The local committee have exerted themselves to the utmost to make the meeting in this respect a thorough success, and it is to be hoped that the meteorologists, who are to have a special conference in connection with the meeting, will take measures to provide the kind of weather which they may be sure their hosts are praying for.

The scientific attractions of the neighborhood will be fully dealt with in the handbook which is in preparation. Ample provision has been made for the usual entertainments in the way of receptions and excursions. A reception by the mayor of Southport in the municipal buildings is announced for Thursday evening, September 10, and on the following afternoon there will be a garden party, also given by the mayor, in Hesketh Park. Saturday will, as usual, be a free day so far as the work of the sections is concerned. Arrangements have been made for a number of excursions to places of interest in the surrounding country, including Windermere, and also for visits to Chester and Manchester. This last should prove especially attractive to members who wish to combine solid instruction with their pleasure, as those taking part in the excursion will be conducted over the works of the British Westinghouse Electrical and Manufacturing company. The company has kindly promised to provide luncheon for the visitors, and opportunity will be afforded to the party of viewing the new

technical school, the John Rylands Library and the Chetham Hospital. On either Monday or Tuesday a garden party will be given by Sir George Pilkington, who is this year one of the vice-presidents of the meeting, and on the evening of the latter day the local committee has arranged to entertain the association at a *conversazione* in the municipal buildings. Interest in the sectional meetings has, it is to be feared, generally begun to wane by the concluding day of the gathering, and accordingly there have been arranged for the afternoon of Wednesday certain excursions which, though unofficial, will probably attract a good many of the members. These are to Messrs. Lever's well-known model village, Port Sunlight, the Diamond Match Works at Seaforth, and the Cunard steamship *Lucania*. Members will also be given on the following day the opportunity of visiting various industrial enterprises of interest, including works for the manufacture of watches, a Lancashire industry which, after falling on evil days, has been revived with a considerable measure of success.

The accommodation for the sectional work of the meeting seems to be ample. The opening meeting on the evening of September 9, when the president, Sir Norman Lockyer, will deliver his inaugural address, will be held in the opera house, while the three evening lectures will be delivered in the Cambridge-hall. The first of these, on Friday evening, will be by Dr. Robert Munroe, on 'Man as an Artist and Sportsman in the Paleolithic Period.' The Monday evening discourse will be by Dr. Arthur Rowe, on 'The Old Chalk Sea and some of its Teachings,' while the lecture to working men on Saturday evening will be by Dr. J. S. Flett, who will give an account of his observations on the recent volcanic eruptions in the West Indies.

One of the most noteworthy features in connection with the first Southport meeting was the inaugural address of its president, the late Professor Cayley. Professor Cayley was one of the most profound mathematicians that ever lived. He was so absorbed in his subject that even on such an occasion he could not wrench himself outside its limits. It was a masterly discourse, dealing with exceedingly abstruse problems in the highest mathematics, and was probably not fully understood by a score of those to whom it was audible. Sir Norman Lockyer is, like his predecessor at Southport, also a specialist, but a specialist in more than one department. His career as a scientific worker has been associated for considerably more than half a century with the spectroscopical observation of the heavenly bodies and related subjects, with brilliant results both in the way of actual discoveries and of hypotheses. Sir Norman Lockyer has for an equally long period devoted his energies to what we may venture to call another speciality, the endowment of research, which he has done much to promote, and it is probably with one department of the latter subject that he will deal in his presidential address at Southport. He will insist, we believe, on the paramount influence of science and scientific research on national progress, and will endeavor to show at some length how largely our national salvation depends on the adequate endowment of our universities. Sir Norman Lockyer's address is sure to be both emphatic and brilliant.

So far as the ordinary work of the various sections is concerned, to judge from the particulars with which the sectional presidents and recorders have kindly favored us, it promises to be quite up to the average, both in quality and quantity. While, as a whole, it will be conducted on the usual lines, and while much of it will ap-

peal only to specialists, in certain of the sections subjects of wide interest will be discussed.

The president of Section A (mathematical and physical science) will be Mr. C. V. Boys, one of the most brilliant, original and unconventional of our younger physicists. No particulars are yet available as to the subject of the address which he proposes to deliver, but his discourse is certain to be interesting and worthy of the occasion. As the International Meteorological Congress, under the presidency of Professor Mascart of Paris, is meeting at Southport at the same time as the British Association, the department of Section A devoted to meteorology and astronomy will this year be particularly strong in meteorological papers. Contributions have been promised by several of the distinguished foreign members of the congress, including Hildebrandson, Paulsen and Panta; and Dr. W. Lockyer will give an account of his researches on simultaneous solar and terrestrial phenomena. The physical portion of the section will be occupied mainly in discussing three questions of importance at the present moment—namely, the nature of the emanations from radio-active substances, the method of dealing with non-reversible processes in the general theory of heat and the use of vectorial methods in physical work. Professor Rutherford, of Montreal, will open the first with an account of the experiments which have led him to the conclusion that the emanations from radium are material; Mr. Swinburne will open the second and the third will be introduced by Professor Henri. It is hoped that it will be possible at the meeting to come to definite conclusions on these three questions.

Professor W. Noel Hartley will preside over Section B (chemistry). He proposes,

in his presidential address, to give a brief account of twenty-five years' work in spectroscopy, applied to the investigation of the composition and constitution of terrestrial matter, both organic and inorganic. He will review the present position of spectroscopical investigation, chiefly in relation to the theory of chemistry, indicating where it may be usefully and profitably extended. The trend of such work at the present time is towards results of a very interesting character. As regards the general work of the section, the number of papers sent in is considerable, and they deal with a great variety of subjects. A paper on 'Dynamic Isomerism,' by Dr. T. M. Lowry, will be one of the reports which have during recent years been a feature of the proceedings of the section. It will consist of a *résumé* of the whole subject of the dynamic isomerism or tautomerism, which has lately attracted much attention, and a fruitful discussion should follow. Dr. A. W. Crossley will contribute a paper on 'Hydro-aromatic Compounds' forming a supplement to the valuable report which he presented at the Belfast meeting last year. It will give the results of the recent investigations undertaken by Dr. Crossley and others on the turpentine, camphors and other hydro-aromatic substances. A paper by Professor W. J. Pope (recorder) and Mr. J. Hübner will show that the luster produced on cotton yarn by mercurization—or steeping, whilst under tension, in caustic soda—is due to a simultaneous shrinkage, swelling and untwisting of the fiber whilst in a gelatinous state. An interesting accompaniment of this paper will be a series of photo-micrographs taken in natural colors. A discussion on the general subject of combustion will be opened by Dr. W. A. Bone with a paper on 'The Combustion of Methane and Ethane,' whilst a somewhat unusual fea-

ture in the program will be papers in French by Count Arnaud de Gramont, entitled 'Sur le Spectre du Silicium' and 'Sur les Procédés de Photographie Spectrale Applicable à la Pratique des Laboratoires de Chimie.' These are but a few items in the program, other contributions including papers on 'Fluorescence,' as related to the constitution of organic substances, by Dr. J. T. Hewitt; 'Essential Oils,' by Dr. O. Silberrad; 'The Action of Diastase on the Starch Granules of Raw and Malted Barley' and 'The Action of Malt Diastase on Potato Starch,' by Mr. A. R. Ling and Mr. B. F. Davis; a contribution to the 'Constitution of the Disaccharides,' by Professor Purdie and Dr. J. C. Irvine and a 'Method of Separating Cobalt and Nickel and the Volumetric Determination of Cobalt,' by Mr. R. L. Taylor. Altogether there is every reason to hope that Section B will this year have a more prosperous meeting than it had last.

The main aim of Professor W. W. Watts, secretary of the Geological Society, in his presidential address to Section C (geology), will be to show the importance and uses of geology in practical life. He will advocate its adoption as a subject of ordinary education, because, in the first place, its study both exercises the observing faculties and encourages the making of hypotheses for the testing and verifying of which there is ample material. Moreover, its pursuit leads to an open-air life in contrast to the confinement in laboratories and museums imposed on the students of other branches of science; for the aim of all geological teaching should be the making of the field geologist; even specialists in paleontology and petrology should be field men as well. Then, again, he will contend that a knowledge of some of the main facts established by geology, such as the extension of time, the antiquity of

man and the evolution of climate and geography, ought fairly to be regarded as part of the stock in trade of the man of average education. Passing to the practical uses of such training and knowledge, he will point out, first, how the eye is trained to appreciate a country and the use of this in reading and mapping topographical features; secondly, the use of the conclusions of geology as a foundation for geographical knowledge; and, thirdly, the importance of geological knowledge in connection with all economic questions relating to mineral wealth. Unfortunately for Section C, the Southport meeting clashes with the International Geological Congress at Vienna, at which several of the leading British geologists are to be present. A number of papers have been arranged for, however, and though none appears to be of very outstanding importance, a fairly full program may be expected. One of the most important contributions, perhaps, will be a paper by Mr. G. W. Lamplugh on the 'Disturbance of Junction-Beds from Differential Shrinkage during Consolidation,' while an account by Mr. J. J. H. Teall of 'The Recent Work of the Geological Survey,' should be of interest. Dr. Smith Woodward has promised a paper which is sure to be of value. Mr. H. W. Monekton (recorder) will lay before the section some notes on 'Sarsen Stones,' Mr. C. C. Moote will contribute a paper on the 'Porosity of Rocks,' Mr. J. G. Goodchild will treat of the 'Origin of Eruptive Rocks,' while Mr. J. Lomas will discuss 'Some Glacial Lakes in Switzerland.' A number of papers dealing with the geology, or particular features of the geology, of various localities have also been arranged for, including an account by Mr. J. Lomas of the geology of the country around Southport. Considerable interest will attach to the first report of the committee ap-

pointed at Belfast to investigate the fauna and flora of the Trias of the British Isles. The committee have this year confined themselves to the study of footprints, and Mr. Beasley furnishes the bulk of the report.

In past years, it will be remembered, zoology and physiology have each been accorded a separate section at the meetings of the British Association. Last year, however, it was decided, in view of the close relation between the two subjects, to combine the two sections, and accordingly at Southport the physiologists will meet with the zoologists in Section D. The president of the united section is Professor Sydney J. Hickson. In the first part of his address he will consider the present position of the endowments and other encouragements for original research in zoological science in this country, and will point out the need there is for further cooperation and consultation on the part of working zoologists in matters affecting the common interests of the science. The second part of the address will be devoted to a consideration of the general problem of the influence of environment in the production of variation in animals. He will take the group of Cœlenterata for special consideration, and point out the bearing that the facts of variation in this group have upon the general question. The remaining work of the section seems likely to provide a very full program. No account of the physiological contributions is yet available, but the papers on zoological subjects alone constitute a fairly long list. A feature of the proceedings following the president's address will, it is hoped, be a discussion on fertilization, in which Professor Bretland Farmer, Dr. M. D. Hill, Professor E. B. Wilson, of Columbia University, and others, are expected to take part. As is the case in most of the sec-

tions, many of the contributions deal with highly technical subjects, which the specialist alone can fully appreciate; but mention may be made of a paper on 'Comparison of Terrestrial and Marine Fauna,' by Professor W. C. McIntosh, and of another on 'Corals,' by Professor J. E. Duerdon, of the University of North Carolina.

The subject of the address which Captain Ettrick W. Creak, C.B., R.N., proposes to deliver to Section E (geography), in his capacity of president of the section, is the connection between geography and terrestrial magnetism. He will point out that terrestrial magnetism is a subject of vital importance to navigation, and of growing interest to science, and after referring to the magnetic surveys of the globe which have in the past been carried out by land and sea, will direct attention to the vast secular changes which are occurring in the earth's magnetism, and insist on the necessity for keeping our magnetic charts up to date. He will then indicate the vast land areas still unvisited by the magnetic observer, in which travelers might find a field for useful work, and will have something to say about the instruments which should be employed. He will also refer to the far more extensive areas of the globe covered by water, in which practically no magnetic observations have been made for many years past, mainly owing to the lack of suitable vessels. The scientific nature of the presidential address is fully reflected in the program of the general work of the section. In the list of papers, records of journeys of exploration are conspicuous by their absence. Colonel Manifold, indeed, will discuss 'The Routes to the Yangtze Valley,' and Mr. J. P. Thomsop, founder and secretary of the Queensland branch of the Royal Geographical Society of Australia, has promised to give an account of the geography of Queensland,

where he has traveled widely. It is also hoped that Lieutenant Shackleton will be able to contribute a paper on 'The National Antarctic Expedition,' in the first year's work of which he took so prominent a part. But the great majority of papers deal with the more purely scientific branches of geography. An important subject down for discussion by Colonel F. Bailey is the 'Denudation of Mountains and its Remedy.' More or less akin to this is 'The Afforestation of Water-works Catchment Areas,' a subject which will be dealt with by Mr. J. J. Parry, special attention being paid to the case of Liverpool. A paper of much practical interest to explorers should be that on 'Improved Methods of Survey for Travelers,' by Mr. E. A. Reeves, the Royal Geographical Society's map curator and instructor, while equally interesting and instructive in another direction will be Mr. E. D. Morel's account of the 'Economic Development of West Africa,' a topical subject of special importance. Other papers to be read before the section are the 'Geographical Distribution of Disease and Disease Carriers,' by Dr. L. Sambon; 'The Melting of Ice in Relation to Ocean Currents,' by Professors Pettersson and Sandström; 'The Importance of Ecology to Geography,' illustrated by slides, by Mr. O. Darbishire; 'The Physical Geography of the Pennine Chain,' by Mr. B. F. Kendall; 'A Botanical Survey of Westmoreland and Cumberland,' by Mr. F. J. Lewis; 'Glareanus, a Sixteenth Century Geographer, and His Manuscript Maps,' by Mr. E. Heawood; and 'The Nomenclature of British Mountain Systems,' by Dr. H. R. Mill. A feature of much interest in the proceedings of the section should be the joint meeting which has been arranged with Section L (educational science), for the purpose of discussing the teaching of geography. Mr.

H. J. Mackinder, reader in geography at the University of Oxford, will open the discussion, and he will be followed by several others who have devoted special attention to this important branch of school work.

In view of the vital questions now at issue with regard to the fiscal policy of the empire, an unusually large attendance may be looked for at the meetings of Section F (economic science and statistics). So far as can be judged from the preliminary list of papers, those who follow the proceedings of the section will have no cause to grudge the time so spent. The subjects on which contributions have been promised are at once of wide general interest and of commanding importance in the life of the nation. As might be expected, not a few of the contributions are connected with the problems now immediately before the country, but the papers to be read and discussed are by no means confined to this subject. As a government official, Mr. E. W. Brabrook, C.B., who is this year president of the section, has naturally steered clear of the much debated question of the day. He has, however, chosen as the subject of his presidential address a topic always attractive, and one that closely affects the national welfare—namely, 'Thrift.' In virtue of his position as chief registrar of the Friendly Societies' Registry, Mr. Brabrook is peculiarly well qualified to speak with authority on this subject, and a highly-instructive address may be looked for. The great accumulation of funds in friendly and other societies and in savings banks will be noted, the principle upon which the legislature has hitherto dealt with these bodies will be defended and its satisfactory results pointed out. Incidentally a number of matters interesting to those who are concerned with provident institutions will be touched upon and dis-

cussed, and the general conclusion drawn will be favorable to these bodies. In the general program of the sectional proceedings, a complete day has been set aside for the consideration of the fiscal questions which Mr. Chamberlain has proposed for discussion. Dr. E. Cannan will discourse on 'The Shibboleths of Free Trade,' Mr. A. L. Bowley, the recorder of the section, will discuss 'The Application of Statistics to Economic Arguments,' making reference to methods of criticism, Mr. H. O. Meredith will relate the 'History of Retaliation,' and Mr. F. Bradshaw will give an account of 'The Commercial Relations between Canada and the United Kingdom,' an historical résumé from early times to the present day. It is also hoped that a day will be devoted to a discussion on 'Our National Income, and How to Spend it.' Sir Robert Giffen is expected to open the discussion. A subject that is attracting a good deal of attention just now is to be dealt with by Mr. Bosanquet, who will read a paper on 'Physical Deterioration and the Poverty Line,' criticizing the statistics advanced on the subject. Different aspects of taxation will be discussed in two or three contributions. 'Sinking Funds in Municipal Enterprise' will form the subject of a paper by Mr. S. H. Turner, of Glasgow University, who will insist on the necessity of distinguishing between sinking funds and depreciation in law and practice. Dr. B. Ginsburg will discuss the growth of rates, and a paper on a kindred subject will be contributed by Mr. J. G. Chorlton. Mr. Lees Smith, of Ruskin Hall, Oxford, has promised a paper on 'Karl Marx's Theory of Value'; and the work of the section will also include the consideration of the final report of the Committee on Legislation affecting Women's Labor. The report will show that information has been obtained on sev-

eral important questions, and that the acts so far passed by Parliament have been the cause of many benefits and of very little visible inconvenience.

The president of Section G (engineering) is Mr. Charles Hawksley. No information as to the subject of his address is available, but the program of the general work of the section shows that the engineers are likely to have a very interesting meeting. Apart from the papers to be read, the various excursions to important industrial works in the neighborhood, to which reference has already been made, should prove specially attractive to members of this section. An interesting contribution will be that by Lieutenant-Colonel Crompton, R.E., C.B., on 'The Problem of Modern Street Traffic.' This paper is intended to open a discussion in which municipal engineers, tramway engineers, police officials, automobilists, and others are invited to take part. A particular aspect of the general problem of vehicular traffic will be dealt with by Mr. J. Clarkson, in a paper on 'Steam Propulsion on Roads.' Mr. W. F. Goodrich will have much that is instructive to say on the subject of 'Refuse Destructors and Power Production,' and, among other contributions, will be papers by Mr. Bell, on 'Oil Fuel'; Mr. Woodhouse, on 'The Newcastle Power Works'; Mr. T. Parry, on 'The Water Supply of South-West Lancashire'; Dr. Campbell Brown, on 'The Growth of Organisms in Water Pipes,' and Mr. B. Hopkinson, on 'The Paralleling of Alternators.'

The address of Professor J. Symington, of Queen's College, Belfast, who is this year president of Section H (anthropology) will deal mainly with the significance of variations in cranial form, and will criticize the view recently revived by Professor G. Schwalbe that the fossil Nean-

derthal skull cap belonged to a species of *Homo* different from recent man. It will also consider the relation between the external and internal forms of the cranial wall. The papers accepted in physical anthropology include a study of the skulls from Round Barrows in Yorkshire, by Dr. W. Wright; papers on skulls from the Malay Peninsula, by Mr. N. Annandale, and on the physical character of the Andamanese, by Dr. Garsin; a note on Grattan's craniometrical methods, by Professor Symington; and important reports on Dr. C. E. Myers' work on the rank and file of the Egyptian Army, on Dr. W. H. R. Rivers' researches among the Todas, and on Mr. Duckworth's investigations among the ancient and modern populations of Crete. The committee on anthropometric methods has a valuable report to present, and that on the teaching of anthropology will probably report *ad interim*. Archeology will be unusually well represented. Mr. Arthur Evans, Mr. J. L. Myres and Mr. R. C. Bosanquet will offer reports on this year's excavations in Crete, Mr. J. Garstang and Mr. Currelly on recent work in Egypt, Mr. G. Clinch on 'A Surrey Monument illustrative of Certain Points in Stonehenge,' Mr. Annandale on 'Stone Implements from Iceland,' Dr. C. S. Myers on 'The Ruins of Kharga in the Great Oasis,' Mr. T. Ashly on 'Roman Work at Caerwent,' and Mr. Garstang on 'Ribchester,' while the usual report on the Silchester excavations may be expected to lead to some discussion. Professor Ridgeway will read a paper on the 'Origin of Jewelry.' General ethnography (with the exception of Dr. Rivers' work on the Todas) and folklore and comparative religion (with the exception of a paper by Mr. W. Crooke on 'Islam in Modern India') are as yet poorly represented, but this de-

fect will probably be remedied before the meeting.

Section K (botany) will meet under the presidency of Mr. A. C. Seward, whose address will be devoted to the subject of fossil plants. After referring to the importance of paleobotanical investigations, as affording evidence bearing on the interrelationships of existing classes and families of plants, the greater part of the address will deal with the leading characteristics and geographical distribution of the older floras of the world. The geographical distribution of extinct plants has received less attention than it deserves, but in spite of the meager character of the available data the subject is well worthy of consideration. The general facies of the vegetation of the Devonian, Carboniferous, Breccian, Triassic and Jurassic periods will be described, prominence being given to such facts as throw light on the methods of plant evolution during the Paleozoic and Mesozoic eras. The main object of the address, however, will be to draw attention to the conclusions which may be looked for as the result of a critical study of the geographical distribution of the floras of the past. As regards the general work of the section, Mr. W. Bateson and Miss E. R. Saunders will read papers on the new discoveries in heredity and will deal with the results of some cross-breeding experiments with plants, maintaining the view that these have arisen from a dicotyledonous ancestor by the union of its two seed leaves. Miss Ethel Sargent will open a discussion on the evolution of the monocotyledons, and Mr. C. C. Hurst will give an account of some recent experiments in the hybridization of orchids. Professor J. B. Farmer will lecture on epiphytes, Messrs. A. G. Tansley and F. F. Blackman will give an account

of important recent advances in our knowledge of the green algæ, Dr. O. V. Darbishire will read a paper on the sandhill and saltmarsh vegetation of Southport, Miss Sargent and Miss Robertson on the seedlings of some grasses, Mr. Harold Wager (recorder of the section) on the staminal hairs of *Tradescantia*, and Professor T. Johnson on a willow canker. The report of the joint committee of Sections K and L on the teaching of botany in schools will be presented, as also reports on the investigation of the Cyanophyceæ and on the respiration of plants.

Section L (educational science) will this year meet for the third time, and so well has it justified its existence that it may now be regarded as an established institution. The president of the section is Sir William de Wiveleslie Abney, K.C.B., principal assistant secretary of the Secondary Branch of the Board of Education, from whom an instructive address may be expected. Following the course pursued at Glasgow and Belfast—a course which might, perhaps, usefully be adopted, in a measure at least, by some of the other sections—the organizing committee has decided to confine the discussions to a few subjects of wide general interest and importance. The first two days of the sectional proceedings will be devoted to an organized discussion on school curricula, based on a series of short papers of which copies will be distributed before the meeting. Papers have been promised by (amongst others) Miss Burstall and Messrs. M. E. Sadler, J. L. Paton, W. L. Fletcher (Liverpool Institute), John Adams and T. E. Page. There will be two main branches to the discussion, one relating to the character of the curriculum suitable for primary (preparatory) schools, the other to the curriculum suitable for

secondary schools. It is hoped that each of these subjects will be discussed very thoroughly. Naturally the latter, being the larger subject, will be the more fruitful in matters for consideration. The general questions which will be raised will be: What subjects, if any, all children should at first study in common; whether the training should not in all cases necessarily include literary instruction and practical instruction (science, drawing, manual and physical training, etc.); and how far up in the schools both these should be carried. Then will be considered at what stage, and to what extent, divergence from the general preparatory courses should take place, and the best curricula will be discussed for schools preparing for (1) commercial professions, (2) domestic professions, (3) engineering and applied science professions and (4) literary professions. Finally the relation in such schools between literary and practical branches of instruction will be dealt with. Besides discussing these important questions, the section will consider the reports of various committees on subjects deserving of careful attention. Four reports will be presented, relating to the conditions of health essential to the carrying on of the work of instruction in schools; the teaching of natural science in elementary schools; the influence exercised by universities and examining bodies on secondary school curricula, and also of the schools on university requirements; and the teaching of botany in schools. This last, as has already been stated, is the report of a joint committee of Sections K and L. Reference, too, has already been made to the meeting which Section L is to hold jointly with Section E for the purpose of discussing the teaching of geography.

*HIGH SCHOOL CHEMISTRY IN ITS RELATION TO THE WORK OF A COLLEGE COURSE.**

THE object in discussing a subject of such latitude as the one assigned me I assume to be to suggest questions, invite criticism and point out defects rather than merits. Two distinct questions claim our attention in discussing the relation of high school chemistry to the work of a college course.

1. Who ought to decide what is the most suitable course for high schools, and how shall such decision be arrived at?

2. What is the most notable defect in the present arrangement and what is the remedy?

I shall also assume that the young man preparing for college should study chemistry by the same methods as the one who is to be a farmer or a merchant. Whatever method is good enough for one is none too good for the other. As the elements of reading or arithmetic are taught alike to the future mechanic and elocutionist or accountant, so differentiation in chemistry should begin with the higher branches only. The question is to find the best system for teaching the science. That question, however, being a matter of individual opinion, is subordinate to the one I purpose to discuss. Who shall be the arbiter and how shall decision be reached?

The methods of yesterday are not the same as those of to-day, and to-morrow will bring its own differences. A generation ago chemistry was taught by recitation and lecture work. Now the laboratory supplements and in some cases supplants these. All new methods tend to extremes; hence those in vogue to-day are not necessarily nor even probably better in every respect than those of

* Read before the Science Department of the National Educational Association, Boston, July 10, 1903.

yesterday, though they may have elements of superiority. A method, for example, which discards entirely the text-book, which does away with recitation, which omits theory, may have some excellent points, but as a whole it is abominable.

In former years it was the custom of college authorities to state the subject matter and largely the methods to be used in the high school which offered preparatory subjects, and other high schools made their own courses. At first this seems eminently appropriate, for the student must be prepared to take up such work as the college offers, at a given indicated point. The college, in that view of the case, rightfully dictated the work for secondary schools. The governing body of each institution was entirely distinct from that of the other, and the only harmonious articulation of the two was the arbitrary 'requisites for admission' to the college, and these differed with different institutions; hence a babel of courses, methods and results. With the growth in the western and central states of state universities, the gulf between high schools and colleges was more easily bridged. But in the east other forces have been at work. Cooperation—the organizing of associations for the teaching of history, English, physics and chemistry, associations in which college professors and high school teachers meet and together discuss methods and formulate systems—has been a powerful factor in bringing into closer union the two classes of institutions. 'Community of interests' is found as desirable here as among railroads, and it stamps our science teaching with twentieth century methods. It is a splendid illustration of this harmony that high school teachers are invited to speak on the same platform with college professors and university presidents, to discuss a common subject. It emphasizes what a few years ago was not so fully recognized, that high

school teachers as a class are not a whit less conscientious, nor perhaps in a majority of cases less qualified for the work they have to do than are their college brethren for theirs.

I believe that colleges can not long afford arbitrarily to say, without consultation of secondary school teachers, that just so much ground must be gone over by just such a method, nor can the high school unadvisedly lay out its course. What can high schools do as feeders of the college? What ought they to be expected to do? Such vital questions can best be answered only by conference and cooperation; for while the professor may know far more of the objective intricacies of the science, he can not understand as the high school teacher does the subjective emanations from the gray matter of the boy's brain and how best to direct those emanations. What is the history, what the tendency of cooperation?

The first club of chemistry teachers known to the writer, for comparing methods of teaching, was the Boston Chemistry Teachers' Association, formed in 1891 at the suggestion of Miss Laura B. White. This club has been in existence ever since and continues to hold monthly meetings during the school year at the Girls' High School in Boston. It is an informal club without organization, but it has done much effective work.

The New England Association of Chemistry Teachers was organized in 1898, by about a score of teachers of the science. The association has grown to not far from 100 members scattered literally from Maine to California. Printed reports of the three meetings per year give full details of papers and discussions and are distributed to each member, besides which occasional records of chemical literature, books and articles are issued. So far as known to the writer, this is the oldest, and to the

present time the largest, organization of its kind in this country. Recently several other societies of a like sort have sprung into existence, one in California (the Pacific Coast Association of Chemistry Teachers) and one in New York state, while inquiries concerning the conduct of our association from western states indicate that others are in process of formation.

These organizations which are sure to increase in numbers and efficiency, will do a great work towards unifying chemistry teaching. It is to be regretted that thus far the high schools are doing the major part of this work. I believe the only organization which can remotely approach to the ideal is that in which both college and high school teachers take a common interest, and enter into the work with equal zeal. In establishing chemistry clubs, therefore, care should be taken that no one class of teachers forms the active membership to the exclusion of the other.

Other associations of chemical workers have grown up, especially as adjunct societies to the large educational organizations of the country, among which the National Educational Association stands preeminent. I need not refer to the science clubs which are a feature in every large college, nor to the American Chemical Society nor the American Association, for these are mainly concerned with research work and facts, rather than with teaching.

But the organization which is doing more than all others at the present time to articulate high school and college work is the College Entrance Examination Board. Originating in 1899 at a meeting of representatives of colleges and universities of the Middle States and Maryland, it has grown so as to include twenty-three institutions, and the second annual report states that of all the colleges and universities in the United States only one declines to ac-

cept its examinations for entrance, three of which have already been held. In such a concentration of forces there is enormous saving of time and a unification of college preparatory work.

There is a second relation which I wish particularly to emphasize in our discussion. Many of our high schools give a fairly good course in general chemistry—experiments, theory and principles—some taking two years and including qualitative analysis, and a little quantitative work. Yet in a great majority of the higher institutions the work must be repeated.

To be obliged to go over again in college the preparation of oxygen, the properties of sulphur, the compounds of iron, which he has already studied experimentally and theoretically, the student regards as a useless waste of time, and reasons that if he must take the subject in college he had better spend his time in the preparatory school on some other branch, the rudiments of which will not be repeated. Thus is high school chemistry placed at a disadvantage in comparison with other elective subjects.

Two sets of reasons are advanced for this failure of the colleges to recognize preparatory chemistry from the fitting school. First and chiefly, because in a majority of such schools the student does not go deep enough into general chemistry to warrant his taking up at once the higher branches—quantitative or even qualitative analysis. He has not had theory enough nor practise enough.

A second reason is that some students offer chemistry for admission, others do not. Hence there must be an elementary course in college for those who have not had the subject prior to entering, and into this class are also put those who have studied chemistry in the schools. Thus side by side in the laboratory, taking also the same lecture notes, are those who do

not know an element from a compound, and those who have passed the searching college-entrance examination.

Wishing to know what is the actual practice in the higher institutions. I sent to each of the twenty-three colleges and universities that contribute to the College Entrance Examination Board, the following among other questions: 'Are those students that have passed elementary chemistry on entrance obliged to take general chemistry again if they continue the subject, or may they go on at once with more advanced work?' The College Entrance people were selected because they are united on a definite object, and are supposed to allow candidates for admission to offer chemistry. The result would probably not vary much if other colleges had been interviewed. Of twenty-three replies to this question (for every one answered it) seventeen are to the effect that the subject must be repeated, though a few say that if the course has been as thorough in the high school as it is in the particular college, the student may go on, implying at the same time that this rarely, if ever, happens. In two cases chemistry was not allowed as an entrance elective. One states unqualifiedly that students may go on, another that they may, but that very few continue the subject. Thus the almost unanimous verdict is: *Repeat*. And the offense with which the high school is charged is *inadequate preparation*.

Wishing to get at the evidence which weighed in the minds of the judges, I put to the same twenty-three institutions this question: 'In what part of the work do you find those offering chemistry most deficient?' To this question fifteen direct answers were given, and as they form the important evidence on which my client is convicted, I quote them.

ANSWERS.

1. Elementary general principles.
2. A comprehension of underlying principles. Pupils acquire facts but do not understand their relation to general principles.
3. Want of application.
4. Work is not thorough; mostly taught from books, ground covered too great for time devoted to it.
5. Elementary logic. Students coming to college are very deficient in reasoning.
6. Equations and laboratory work.
7. Making, putting up and using apparatus; a thorough knowledge of the non-metals; quantitative experiments.
8. Their failings will vary with the instruction they have received.
9. In general.
10. Perhaps theoretical more than descriptive.
11. Have generally 'done' a large number of experiments, but are sadly deficient in chemical laws.
12. In theory and in knowledge of metals.
13. Equations and familiarity with fundamental principles. Three fourths of the time at high schools is wasted in trying to cover too much ground.
14. They fail because they will not study, and I think in many cases they were never taught how to study.
15. The fifteenth and last is a venomous arraignment of high schools, untrue as it is unkind. Its author says: "The preparatory schools are not in a position to give students anything like the comprehensive instruction in elementary chemistry. In the first place, they can rarely afford to hire a chemist to give the instruction. They only get a school teacher who has a smattering of chemistry, and not a real chemist. In the second place, they never have much apparatus, so at best preparatory chemis-

try does not amount to much. The student does not get enough of it to amount to a row of pins. Now, on the other hand, the university professor begins at the beginning. He can not skip oxygen or hydrogen or nitrogen or water or the atmosphere because the students have heard these names once or twice in school," etc.

Such a scathing anathema, besides degrading the high school teacher's work, and elevating to the pedestal the university professor's, shows ignorance of high school chemistry as taught to-day. Hundreds of these schools have as teachers graduates in chemistry from colleges and technological schools, and scores have degree men from German and American universities who are 'real chemists,' and whose work compares favorably with that done in college. Again, it is the exception that high schools now building and recently built are not well equipped with laboratories. Within ten miles of this spot there is a high school chemical laboratory on which there was laid out for repairs alone last year more than \$10,000, and another high school plant in the same city whose original cost more than thirty years ago was \$40,000. Two weeks ago, happening to be in a city of only 25,000 people, in another state, I visited a high school laboratory better equipped than any college laboratory doing the same grade of work that it has been my fortune to examine.

This statement might have been true twenty-five years ago; it is probably true now of some remote country high schools. Its iteration by only one out of twenty-three shows that most colleges recognize the improved conditions in high school work.

Yet from these replies of representative higher institutions there seems no doubt that preparatory schools are trying to do too much and are really doing too little. Where is the fault, and what is the remedy?

A majority of the replies state distinctly that the deficiency is in laws and general principles; that students can not sufficiently correlate facts and theories. The teaching of laws, general principles and chemical theory assumes, therefore, paramount importance and constitutes the great desideratum. Elsewhere I have dwelt upon the importance of theory teaching, and the verdict of these colleges is a convincing corroboration.

While the inculcation of principles and laws is acknowledged by every instructor to be the most difficult part of his work, something to be avoided by the easy-going teacher and slothful student, yet it is recognized as the only thing that can give a broad grasp of the subject and, with requisite experiments, yield the largest results. The tendency in some quarters to omit the application of these broad principles, to abolish the text-book, to abuse the laboratory by excessive use to the exclusion of recitation and lecture, should be viewed with only temporary alarm, for such abnormalities will finally right themselves when the ideal course is adopted.

Entering college on chemistry is a comparatively recent thing. The colleges are the pacemakers, and the high schools are trying their best to keep up.

In the elective system that subject must take the place of so much mathematics, or some ancient or modern language. To be the equivalent of any one of these, a great deal of ground must be covered—the non-metals and the chief metals, laws and general principles, the chemical theory including nomenclature, symbolization, etc. The fitting schools have tried to cover all this extensive ground, and, as most of these schools give but one year of three to five hours per week to chemistry, the result has been—to borrow Mr. Morgan's phrase of 'undigested securities'—a vast amount

of *undigested facts*. Little wonder the students are deficient in 'elementary logic,' in power of 'application,' and that 'their failures vary with the instruction they have received,' or failed to receive. The colleges, on the other hand, have set examinations to fit a one-year crammed course and have admitted students that were confessedly unable to go on with the higher branches of the subject, and were thus forced to repeat in a more thorough manner the work of the preparatory school. This unnatural loss of time and energy can not long continue in a quickened educational atmosphere. Two roads lead out of the woods. Let the authorities explicitly state that thorough preparation in the entire field of general chemistry can not be had in less than two years of five hours per week in a well-equipped laboratory. Make the examination rigid enough to meet this demand, and when the student has entered college, do not require him to repeat his work, but give him advanced standing, as he would have in Latin or mathematics. This is one road. The other, and I believe better one, is: Limit the requirement to one year's work; cut out the consideration of metals except as they incidentally appear in salts and acids radicals; demand a thorough course in the non-metals, the chemical theory, laws and general principles. Then, as in the other case, do not ask the student to waste another year or half year in repetition, but give him advanced work, beginning with metals.

Either of these plans would relegate the rudiments of the science to the high schools as is fitting. Why should the college teach high school chemistry any more than high school English, or high school algebra? I believe it is *almost*, if not altogether, as important that every high school graduate should know something of the composition

of the air he breathes, the constituents of the food that nourishes him and the reactions of the fuel that keeps him warm, as to know the binomial theorem or the proof of the *pons asinorum*. Why require the latter as a prerequisite to entrance upon a liberal education, and omit the former? When colleges take the same stand concerning the fundamentals of chemistry which they assume in English and in mathematics, a great advance will have been made. As Cæsar is read in a preparatory Latin course, and not again studied in college, let oxygen, carbon and silica be relegated to the secondary schools, and the college course begin with metals, analysis, etc. This division line is purely arbitrary, but it serves my purpose of illustration. Any other division mutually agreed upon by conference of representatives of the two classes of institutions would serve equally well. I believe it to be entirely practicable for a conference of college and high school men to lay out a course with experiments to cover the required ground so satisfactorily that no repetition shall be needed.

I believe this subject is worthy of the most serious consideration from an economic standpoint. Last year President Butler gave an address before this association on the waste of time between the primary school and the university, and this week the discussion has been renewed under other forms by the college presidents. Right here is our chance for contribution. Save a year in chemistry. I believe it to be the plain duty of colleges and high schools to cooperate in formulating such a plan. Especially it seems to me that a strong point can be scored by the examination board that has undertaken the task of unifying entrance examinations and preparatory work, of setting a model which the high schools shall attain unto, in order that a

year of school life be not lost, that the student may begin in college where he leaves off in the high school, with preliminary work reasonably complete and satisfactory.

RUFUS P. WILLIAMS.

SCIENTIFIC BOOKS.

Municipal Public Works, their Inception, Construction and Management. By S. WHINERY, Civil Engineer. New York, The Macmillan Company. 1903. 8vo. Pp. 241. 8½ in. by 5½ in.

This is an excellent book on a subject which is more and more attracting the attention of the general public. It is written by an experienced engineer 'for the inexperienced city official and for the urban citizen.' Although it treats of engineering subjects it is not a book of engineering. It is rather a book of public policy in municipal engineering affairs, and as such it differs from many books which have recently appeared with similar titles.

The early chapters in the book are elementary, describing the scope of municipal works, the relation to them of the engineering departments and the manner of financially providing for their support. The author then takes up the question of contract work, and discusses various details of it, such as advertising, preparing specifications, opening bids, awarding contracts, supervising the work, etc. He favors contract work as opposed to work done directly by the city, but points out many weak points in the ordinary contract. Contractors he divides into three classes—the honest and responsible contractor, the irresponsible and unreliable contractor and the boodler; and his descriptions of the conditions which operate to develop these different individuals are most instructive. He is strongly opposed to the compulsory award of contracts to the lowest bidder, and believes that in this, as in many other matters, the engineer or the commissioner should have more latitude and be held personally responsible for the result. In some of these matters the author is at variance with present custom, his theory being,

apparently, that there is less chance of bad results due to the use of autocratic power by an occasional dishonest or unfit official than by the operation of laws which continually hamper honest officials and which are ignored or broken by the dishonest ones.

Perhaps the most valuable portion of the book is that which relates to the financial side of municipal works. The subjects of guarantees, special assessments, uniform accounts, municipal ownership, quasi-public corporations are treated in special chapters. His criticisms of the ordinary methods of municipal accounting are severe, but none too severe, as any one will admit who has attempted to compare the cost of any class of municipal work for different cities. And he is quite right when he says that many questions of public policy are being to-day obscured because of false statements issued with no intention to deceive, but simply as a result of bad book-keeping. Among these questions he places that of 'municipal ownership' of public utilities, and while not wholly deprecating the modern trend toward public purchase of private water works, electric light works, etc., he believes that such changes should be made only after a more complete study of all the financial elements which enter into the question than is usually given to it. His comments upon the proper treatment of such matters as maintenance, operating expenses, interest, depreciation, sinking funds, in connection with the valuation of private property are worthy of serious consideration.

Instead of the wholesale municipal assumption of public utilities he favors private ownership under suitable control, and in the last chapter he outlines a plan and offers it as a solution of this vexed question. He would organize all quasi-public corporations under a general state law, similar in its general features to the present interstate-commerce law, and would make the law 'so radical and far-reaching as to assume, within limitations, the absolute control of quasi-public corporations and of their relations between them and the municipal corporations.'

Whether or not the reader agrees with all the author's conclusions upon the questions

discussed, he will admit that his points are well argued and that the book has given him a clear outlook upon the broad subject of municipal works.

GEORGE C. WHIPPLE.

DISCUSSION AND CORRESPONDENCE.

ELECTRICITY AT HIGH PRESSURES.

TO THE EDITOR OF SCIENCE: Some three or four years ago* I put forward the idea that just as with increase of vacuum and potential the Roentgen rays become more and more penetrating, there may possibly be produced, when cathode ray ions (electrons) move with the very highest velocities, rays that penetrate considerable thicknesses of nearly all bodies without undergoing absorption. Interstellar space may be traversed not only by light and heat waves, but also by rays of the more recently discovered penetrating kinds including those of extreme penetrating powers above assumed as possible.

From what source would such highly penetrating rays as are referred to come? Might they not come from matter (electrons or assemblages of electrons called atoms, or even small masses of matter) moving with such very high velocities as are somewhat comparable with the velocity of light? These assemblages of electrons on impact would probably give Roentgen rays of all orders up to the very highest or most penetrating. Such rays would be absorbed only in larger or denser masses of matter and the absorption would ordinarily be undiscoverable. The celestial bodies, as the stars, planets, etc., would probably absorb the rays, and the rays in being so absorbed would add energy to the masses, tending to some extent to keep up their temperature.

The natural question arises as to whether there are any existing conditions under which the smallest particles could attain high velocities. When an extremely minute particle of matter near the sun or in the outer envelope of gas around the sun is of a nature to absorb the radiation, a radiation pressure will be exerted

upon it which may, if the particle is small enough, be in excess of gravitational force. Such particles continuously expelled, in virtue of the excess of radiation pressure over gravitation, may give rise to the coronal streamers around the sun. If the condition just pointed out be possible, the particle will, under the difference of force, be accelerated outwardly from the sun, and continue to move away with an acceleration which, though diminishing, is still an acceleration. Such particles would naturally be expected to leave or be driven away from any hot star.

That a particle once started away will continue moving outwardly with an acceleration, follows from the fact that both the radiation pressure and gravitation vary as the inverse squares of the distances. This means that if a particle is moving towards the sun under the influence of gravitation, it will not at any time be stopped by the radiation pressure unless it be subdivided into smaller particles. It also means that any set of particles moving from the sun under radiation pressure in excess of gravitation must continue forever moving away, unless such particles are brought together into large masses or collide with other masses. It is possible that the limiting velocity which could be attained would be the speed of light waves in the ether. Such rapidly moving particles, whether consisting of many molecules or atoms (groups of electrons) or consisting of separate electrons or ions would probably, on striking other particles or masses, give out intense radiation of the Roentgen ray order, and accompany the same by heat radiation, or visible radiation, or both. Such particles might even serve to illuminate some of the apparently cold nebulae, either by the impact generating heat and light, or by fluorescence.

Here, then, is the outline of a new corpuscular theory of energy conservation, which is not the Newtonian corpuscular theory, but which supplements the undulatory theory in providing a mode of recovery for at least a portion of the energy of radiation. Any particle which is set in motion by the radiation pressure is within limits converting the energy of radiation into mechanical move-

* 'Electricity at High Pressures,' lecture before the New York Electrical Society, March 29, 1899.

ment or moment, which movement continues until such particle meets an obstacle and the energy is again reconverted to heat, light and to those forms of obscure radiation, more or less penetrating to ordinary matter.

It is doubtful whether radio-active substances like radium are the fluorescent detectors of such rays as reach us from space, and which are not absorbed by our atmosphere. The simpler hypothesis is that of atomic instability. But the hypotheses which have been outlined above—and they are, of course, only scientific speculations or hypotheses as yet—naturally suggest lines of investigation which are desirable to be carried out. In that way only can any truth, if it exists in these ideas, be determined; or the ideas disproved, as the case may be.

ELIHU THOMSON.

A POSSIBLE USE FOR RADIUM.

ON the authority of M. Curie radium is worth about one million dollars a pound. This estimate is based on the cost of isolating this rarest, newest and most wonderful of the metals, rather than upon its uses to practical people.

Utilitarians may demand: 'Of what use is radium?' Sir Oliver Lodge has said this is difficult to answer for people who wish to make money out of it, but although at present radium grinds no axes, it is held in great estimation by physicists who see in its amazing energy possible solutions for old problems and materials for new ones. A British writer in the *Daily Graphic* of July 13 points out one direction in which a study of the properties of radium may prove of the greatest benefit to mankind, and that is the analogy between its rays and those of luminous insects. As Sir Oliver Lodge remarks, if we could discover the secret of the fire-fly's power to convert some unknown source of energy into light, we could produce light without heat.

Hope is expressed that the study of radium may lead us to a method of obtaining light in a cheaper and more convenient manner than any now known.

X.

SHORTER ARTICLES.

THE FISHES OF THE AFRICAN FAMILY KNERIIDÆ.

IN 1866 Dr. Steindachner introduced into the ichthyological system a peculiar western African fresh-water fish which he called *Kneria angolensis* and referred to the family Acanthopsideæ or Cobitidæ. Two years later (1868) Dr. Günther added another species from central Africa (*Kneria spekii*) and ranked the genus as the representative of a peculiar family—Kneriidæ. He placed it as an 'Appendix to the Cyprinidæ,' and there it has ever since been allowed to remain, but I have always felt convinced that it was not at all related to the Cyprinids or Plectognaths even. Very recently data have been acquired which may help us to a solution of the taxonomic problem.

In 1901 Dr. Boulenger made known a remarkable pigmy fish (30 mm. long) from the upper Nile (Fashoda) which he named *Cromeria nilotica* and referred to the family Galaxiidæ, thinking that it 'appears to be most nearly related to *Galaxias*.'

It is very unlikely that the tropical fish should be a member of a family all of whose certain representatives are characteristic of the cool and cold waters of the southern hemisphere and I was inclined to believe that it was really related to the Kneriidæ. An important paper just published by Dr. Swinnerton appears to confirm this view.

In the *Zoologischer Jahrbücher* (Anatomie) published in June, 1903 (pp. 58-70), Dr. Swinnerton has given an article on 'The Osteology of *Cromeria nilotica* and *Galaxias attenuatus*' and made known some extremely interesting results. It appears that there is no relationship between *Cromeria* and the *Galaxiids*, and that *Cromeria* belongs to a peculiar family remarkably distinct from any other known unless it be that of the kneriids. To that, indeed, it seems to belong. It has the same general form, the same arrangement of the fins, the projecting snout or upper jaw, the toothless trenchant jaws, the absence of pharyngeal teeth, the three branchiostegal rays, the very narrow branchial apertures, and the simple air-bladder. Indeed, in all essential

respects, *Cromeria* appears to agree with *Kneria*. There are, however, two notable discrepancies.

Kneria has 'the margin of the upper jaw formed by the intermaxillaries,' according to Dr. Günther, while in *Cromeria* Dr. Swinnerton found that 'both premaxilla and maxilla are small and edentulous,' and that 'the latter overlaps the former dorsally and enters largely into the formation of the gap.' In view of the very small size of the fishes and the ambiguous character of the mouth parts, the apparent difference may be rather nominal than real.

Kneria has its body 'covered with very small cycloid scales,' while *Cromeria* has the body 'naked.' Further, *Kneria* has a normal tail, while *Cromeria* has a membranous extension from the caudal above and below. It is possible that both of these characters may be indicative of immaturity (as analogous ones are in some other fishes) but it may be better for the present to assume that the two genera *Kneria* and *Cromeria* are distinct; that they are related there is little doubt.

The family, as represented by *Cromeria*, is so remarkably distinguished by osteological characters, especially the attachment of 'the greatly elongated arm of a bifurcated post-temporal to the supra-occipital bone,' that it should be isolated as the representative of a peculiar superfamily—*Knerioidea*. As Boulenger and Swinnerton have indicated, the scapular arch being destitute of a mesocoracoid, the group may provisionally be associated in the same great group as the pikes and killiefishes—*Haplomi*—or, perhaps better, in the group *Iniomi*, inasmuch as the family agrees with those fishes in their technical characters. Whether such an association would be natural will be for the future to determine.

THEO. GILL.

THE FLORA OF THE SERPENTINE BARRENS OF SOUTHEAST PENNSYLVANIA.

PARTS of Montgomery, Delaware, Chester and Lancaster Counties, Pennsylvania, are noted from a geologic standpoint for the presence of outcrops of serpentine rock. This rock formation is confined to the district

southwest of the Schuylkill River, extending in a somewhat southwestward direction into Maryland, near the lower Susquehanna River. The largest outcrops near Philadelphia occur in the neighborhood of Lima, Delaware County, at Newtown Square, at places north and southwest of West Chester, while isolated patches exist south of Bryn Mawr and northwest of Media. There seems no doubt but that all the serpentines in southeast Pennsylvania are altered igneous rocks, either pyroxenites or peridotites.*

The flora of the serpentine exposures, which are always more or less barren in appearance, is peculiar. The eye of the botanist, or of the observant layman, is at once arrested by the association of the characteristic species which make up the serpentine flora, because it is sharply demarcated from the flora of the surrounding country. The botanist can identify the serpentine areas, where the rock is covered by a shallow soil, by the vegetation alone, for the species which are character plants, although occurring elsewhere in the region, are here grouped together in such a manner and in such number, as to delimit sharply these areas from the surrounding country. The serpentine plants taken together, therefore, form islands set down in a sea of other vegetation with a boundary as well characterized as the shore of an oceanic island, and with tension lines induced by the struggle for existence as sharply drawn as the shore line against which the storm waves beat. This sharp delimitation of the boundaries of the serpentine areas is emphasized by the fact that these areas are rarely cultivated, but are surrounded by rich cultivable land from which the original vegetation has been removed by man. Many of the plants found on the serpentines have survived, therefore, such vicissitudes and have persisted on the barrens, while the same species have been exterminated in the cleared land. This fact, however, does not militate against the unique character of the serpentine flora, because the forest, which exists on soils other than the serpentine, is

* Rand, Theodore D., 'Notes on the Geology of Southeastern Pennsylvania,' *Proc. Acad. Nat. Sci. Phila.*, 1900, p. 305.

of an open type with the presence of a large number of shade-loving plants, such as *Sanguinaria canadensis* L., etc., which are not found as constituents of the barren flora.

Ten representative serpentine barrens were studied by the writer, viz:*

A. Glenriddle, Delaware County, Pa., on the road leading to the borough town of Lima.

B. Serpentine in the valley west of Black Horse Hotel.

C. Serpentine east of Black Horse Hotel.

D. Serpentine at Williamson School.

E. Serpentine lying between Newtown Square and Darby Creek.

F. Serpentine opposite Castle Rock on east side of Crum Creek along Preston Run.

G. Serpentine near Westtown, Pa.

H. Pink Hill near Lima, Delaware County, Pa.

I. Brinton's Quarry near Westtown, Pa.

Ecologically the flora of the serpentine barrens belongs to the mixed deciduous forest and barren treeless formations. Several plant associations are recognizable, so that an ecologic classification of the plants is as follows:

MIXED DECIDUOUS FOREST FORMATION.

Juniperus-Acer-Nyssa-Quercus Association.

Sassafras Association.

Aspidium-Asplenium Association.

Dicksonia Association.

BARREN TREELESS FORMATION.

Cerastium Association.

Phlox Association.

Deschampsia Association.

Carex-Eleocharis Association.

Spiræa Association.

Rosa Association.

Rubus Association.

Kalmia Association.

Smilax Association.

These formations and associations will be described as they exist on the several serpentine areas mentioned. They are controlled

* The map used in this botanic survey accompanies Penn. Second Geological Survey, Delaware, Part. I., C. 5.

largely by edaphic conditions. Thus the forest type exists where the geologic formation is covered by a surface layer of soil of some depth. The barren treeless formation exists where the serpentine rock is exposed with little or no surface soil. Where springs occur and the soil is wet, the character of the associations is determined by the amount of soil water.

A. SERPENTINE AT GLENRIDDLE, PA.

The barren above Chester Creek at Glenriddle along the road leading from that place to Lima is distinguished by the dominance of *Quercus stellata* Wang. [*Q. minor* (Marsh.) Sarg.],* *Quercus nigra* L. [*Q. marylandica* Muench], *Quercus alba* L., *Acer rubrum* L., *Juniperus virginiana* L., *Castanea sativa* Mill. var. *Americana* Gray [*Castanea dentata* (Marsh.) Borkh.], *Sassafras officinale* Nees [*S. sassafras* (L.) Karst.], and *Cornus florida* L. (MIXED DECIDUOUS FORMATION *Juniperus-Acer-Nyssa-Quercus Association*). The secondary species beneath the shade formed by the above-mentioned are *Rhus glabra* L., *Viburnum dentatum* L., *Vaccinium stamineum* L. [*Polycodium stamineum* (L.) Greene], *Gaylussacia resinosa* Torr. & Gray [(Ait.) Torr. & Gray], *Vaccinium pennsylvanicum* Lam., *Viburnum acerifolium* L. and *Salix tristis* Ait. The lianes, or climbing plants that festoon the trees, are *Vitis æstivalis* Michx., *Smilax rotundifolia* L., *Smilax glauca* Walt., *Rhus toxicodendron* L. [*R. radicans* L.]. The herbs found here are *Hieracium venosum* L., *Pteris aquilina* L. [*Pteridium aquilinum* (L.) Kuhn], *Antennaria plantaginifolia* Hook. [(L.) Richards], *Baptisia tinctoria* R. Br. [(L.) R. Br.], *Rubus triflorus* Richardson [*R. Americanus* (Pers.) Britton], *Potentilla canadensis* L., *Rumex acetosella* L., *Veronica agrestis* L., *Hypoxis erecta* L. [*H. hirsuta* (L.) Coville], and *Lysimachia stricta* Ait. [*L. terrestris* (L.) B. S. P.], all species usually found in dry situations like the sandy pine barrens of New Jersey. In fact, there is a striking similarity in the floras

* Names according to Gray, sixth edition, with names in parenthesis according to Britton's 'Manual of the Flora of the Northern States.'

of the serpentine barrens and the pine barren region of New Jersey.

B. SERPENTINE IN THE VALLEY, WEST OF BLACK HORSE HOTEL.

Here is found a typical exposure of serpentine rock. The barren treeless areas (BARREN TREELESS FORMATION) are characterized by the clumps of *Cerastium oblongifolium* Torr. [*Cerastium arvense* L. var. *oblongifolium* Holl & Britt.] (*Cerastium Association*), *Panicum latifolium* L., *Rumex acetosella* L., *Trifolium repens* L. Near by on somewhat similar barren areas occur thickets of green briars *Smilax rotundifolia* L., *Smilax glauca* Walt. with *Juniperus Virginiana* L. and *Nyssa sylvatica* Marsh rising out, as solitary specimens, from the tangled mass of briars (*Smilax Association*). *Rubus villosus* Ait? (Gray) [*R. nigrobaccus* Bailey], *Rosa lucida* Ehrh. and *Spiraea salicifolia* L. form pure growths (*Rubus, Rosa, Spiraea Associations*), while separating these are grassy stretches, where the botanist finds *Oenothera fruticosa* L. [*Kneiffia fruticosa* (L.) Raimann], *Cerastium oblongifolium* Torr., *Arabis lyrata* L., *Deschampsia cæspitosa* Beauv. (*Deschampsia Association*), *Sisyrinchium angustifolium* Mill., *Senecio aureus* L. var. *balsamitæ* Torr. & Gray [*Senecio balsamitæ* Muhl.], *Geranium maculatum* L. The swampy areas, formed by springs, support *Carex utriculata* Boott., *Eleocharis ovata* R. Br., *Danthonia sericea* Nutt., *Tradescantia pilosa* Lehm. (*Carex-Eleocharis Association*).

In an adjacent barren (C), a stream flows through the woods formed by *Acer rubrum* L., *Liriodendron tulipifera* L., *Juniperus virginiana* L. and *Nyssa sylvatica* Marsh. Along the borders of this stream, and therefore in wet soil, grow *Lindera benzoin* Blume [*Benzoin benzoin* (L.) Coulter], *Aspidium acrostichoides* Swartz [*Dryopteris acrostichoides* (Michx.) Kuntze.] and *Asplenium trichomanes* L. (*Aspidium-Asplenium Associations*).

D. SERPENTINE AT WILLIAMSON SCHOOL.

The dominant trees on the serpentine barrens at Williamson School are *Quercus alba* L., *Quercus rubra* L., *Quercus stellata* Wang.

[*Q. minor* (Marsh.) Sarg.], *Quercus nigra* L. [*Q. marylandica* Muench.], *Acer rubrum* L., and *Juniperus virginiana* L., while associated with these trees are *Sassafras officinale* Nees [*S. sassafras* (L.) Karst.], *Rhus glabra* L., *Kalmia latifolia* L. (*Kalmia Association*), *Salix tristis* Ait., and as lianes, *Vitis æstivalis* Michx., *Ampelopsis quinquefolia* Michx. [*Parthenocissus quinquefolia* (L.) Planch.] and *Smilax rotundifolia* L. The following herbaceous plants grow on the barrens here, *Pteris aquilina* L. [*Pteridium aquilinum* (L.) Kuhn], *Senecio aureus* L. var. *balsamitæ* Torr. & Gray [*Senecio balsamitæ* Muhl.], *Geranium maculatum* L., *Trifolium agrarium* L. [*Trifolium aureum* Poll.], *Aspidium acrostichoides* Swartz [*Dryopteris acrostichoides* (Michx.) Kuntze] and *Castilleja coccinea* Spreng [(L.) Spreng].

E. SERPENTINE AT NEWTOWN SQUARE.

The dominant trees of this serpentine outcrop consist of the chestnut *Castanea sativa* Mill. var. *Americana* Gray [*C. dentata* (Marsh.) Borkh.], the red maple, *Acer rubrum* L., the beech, *Fagus ferruginea* Ait. [*F. americana* Sweet], black cherry *Prunus serotina* Ehrh., *Quercus rubra* L., *Quercus alba* L., *Quercus nigra* L. [*Q. marylandica* Muench.] and *Juniperus virginiana* L. As secondary species of this forest occur *Amelanchier canadensis* L. [(L.) Medic.], *Sassafras officinale* Nees [*S. sassafras* (L.) Karst.], *Carpinus caroliniana* Walt., *Corylus americana* Walt., *Rosa lucida* Ehrh., while as climbing species *Smilax rotundifolia* L., *Vitis æstivalis* Michx., *Ampelopsis quinquefolia* Michx. [*Parthenocissus quinquefolia* (L.) Planch.] form impenetrable thickets. *Vaccinium pennsylvanicum* Lam., *Gaylussacia resinosa* Torr. & Gray [(Ait.) Torr. & Gray] form the undergrowth associated with three ferns, *Aspidium acrostichoides* Swartz [*Dryopteris acrostichoides* (Michx.) Kuntze], *Asplenium trichomanes* L. and *Dicksonia pilosiuscula* Willd. [*Dennstædtia punctilobula* (Michx.) Moore], *Galium aparine* L. (*Aspidium-Asplenium, Dicksonia Formations*). The treeless barrens support *Cerastium oblongifolium* Torr., *Senecio aureus* L. var. *balsamitæ* Torr. & Gray

[*Senecio balsamita* Muhl.] and *Erigeron* Pers. [(L.) Pers.] (BARREN TREELESS FORMATION. *Cerastium* Association).

F. EAST SIDE CRUM CREEK ALONG PRESTON RUN.

A large part of this exposure is treeless, and upon the broken-down serpentine rock grow mats of *Phlox subulata* L. (*Phlox* Association), *Trifolium agrarium* L. [*T. aureum* Poll.] *Pteris aquilina* L. [*Pteridium aquilinum* (L.) Karst.], *Verbascum blattaria* L., *Panicum latifolium* L., *Potentilla canadensis* L. and *Cerastium oblongifolium* Torr. (*Cerastium* Association). The trees are the same as the botanist finds on the other serpentine barrens mentioned. Thickets of green briars are also characteristic of the treeless areas here.

A study of the flora of these rocky exposures reveals the fact that the same association of species is not found on all of the serpentine barrens. The several component species differ as the localities differ, although the same general character of the vegetation is preserved by the presence of several dominant plants, found on all of the barrens. The red cedar *Juniperus virginiana* L., the barren oak, *Quercus nigra* L. [*Q. marylandica* Muench.] the white oak, *Quercus alba* L., the sour gum, *Nyssa sylvatica* Marsh., the sassafras, *Sassafras officinale* Nees [*S. sassafras* (L.) Karst.], the smooth upland sumac, *Rhus glabra* L., the red maple, *Acer rubrum* L., may be said to be the dominant character species, while on most of the barrens, although not found on all, occurs the chestnut, *Castanea sativa* Mill. var. *americana* Gray [*C. dentata* (Marsh.) Borkh.]. When the growth of these trees is dense the serpentine areas are rendered impenetrable in many places by the green briars, *Smilax rotundifolia* L., *Smilax glauca* Walt., the lianes, *Vitis æstivalis* Michx. and the Virginia creeper, *Ampelopsis quinquefolia* Michx. [*Parthenocissus quinquefolia* (L.) Planch.], which festoon the trees and intertwine with each other to form a dark gloomy forest inhabited by the cotton-tail rabbit. Where the ground is too barren to support trees, which usually grow in situations where

there is considerable surface soil, the green briar, *Smilax rotundifolia* L. associated with *Smilax glauca* Walt. covers the ground with a dense growth separated by intervals of grass, where the botanist finds the small sun-drops, *Oenothera fruticosa* L. [*Kneiffia fruticosa* (L.) Raimann], tufted hair grass, *Deschampsia cæspitosa* Beauv., associated with the blackberry, *Rubus villosus* Ait? (Gray) [*R. nigrobaccus* Bailey], and meadow-sweet, *Spiræa salicifolia* L. These treeless areas can be distinguished at a distance by the clumps of briars, by the presence of sentinel-like red cedars, and by an occasional sour-gum tree.

The one herb found on all of the serpentine exposures is the barren chickweed, *Cerastium oblongifolium* Torr. [*C. arvense* L. var. *oblongifolium* Holl & Britt.], which varies from a dwarf cespitose herb to one that, taller and more distinctly branched, covers acres of ground. Some of the barrens are distinguished by the presence of matted growths of the moss pink, *Phlox subulata* L. Such are the barrens at Pink Hill (H) and along Preston Run (F), where extensive areas are covered by this herb associated with the barren chickweed and the woolly blue violet, *Viola ovata* Nutt. Upon one or two of the barrens, viz., Westtown, Pa. (G), and Edgmont, Pa.,* grows the fame flower, *Talinum teretifolium* Pursh. This plant is clearly controlled in its distribution by edaphic conditions, for it is found, and its nearly related species, *Talinum rugospermum* Holzinger, on a variety of rock formations throughout the eastern United States.† The barren at the Williamson School is noted for a growth of laurel, *Kalmia latifolia* L., dwarf willow, *Salix tristis* Ait., and until recently was visited by botanists for the scarlet painted-cup, *Castilleja coccinea* Spreng [(L.) Spreng].

* On the authority of Mr. Benjamin H. Smith, who ascertained the locality from Mr. Witmer Stone.

† Harshberger, J. W., 'An Ecological Study of the Genus *Talinum*,' *Bulletin Torrey Bot. Club*, XXIV., p. 182.

Holzinger, J. M., 'The Geographical Distribution of the *Teretifolium* Group of *Talinum*,' *Asa Gray Bulletin*, VIII., p. 36.

One fact is proved abundantly by a study of the flora of the serpentine barrens, and that is that the chemical character of the soil derived from a disintegration of the serpentine plays an unimportant part in the distribution of the plants mentioned. The distribution of such species is due rather to the physical conditions of the soil, especially with reference to water conductivity and water storage capacity (edaphic conditions). The variation in the character of the plant associations described above is in the main due to the character of the soil. If the soil is present as a well-marked surface layer, then tree associations are found; if on the other hand the rock is exposed, herbaceous associations are the rule. The surface layers of serpentine rock are broken by weathering into angular fragments, which, lying loosely together, permit the percolation of the rain water down into the seams of the underlying rock. Such exposures, therefore, support plants that have adapted themselves to living in dry situations and have structural arrangements which prevent a rapid loss of water.

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THE AMOUNTS OF READILY WATER SOLUBLE SALTS
FOUND IN SOILS UNDER FIELD CONDITIONS.

In the investigations of the Division of Soil Management, in the Bureau of Soils, relating to the influence of soil moisture in crop production it has been found essential to take into consideration not only the varying amounts of available moisture in the soil but also the readily water soluble salts which this moisture carries in solution.

The sensitive and rapid methods which have been devised or adapted for this work enable us to determine the K, Ca, Mg, NO_3 , HPO_4 , SO_4 , Cl, HCO_3 , and SiO_2 in the soil with an accuracy of duplication ranging usually from one to five parts per million of the dry weight of the soil examined and with rapidity such that eight men are able to complete the nine sets of determinations on twenty samples daily between 9 A.M. and 4 P.M.

As these methods are now used in our soil investigations, those for the K, Cl and HCO_3

have been devised and adapted under the direction of Dr. F. K. Cameron; that for NO_3 by A. R. Whitson of Wisconsin and the writer; that for HPO_4 and SiO_2 by Dr. Oswald Schreiner; those for Ca and Mg by Dr. Schreiner and W. S. Ferris, and that for SO_4 by J. O. Belz. The clear soil solutions for examination are obtained by using the effective filter devised by Dr. Lyman Briggs.

After extended observations it has been found that to recover the maximum amount of the readily water soluble salts which are present in the soil it is necessary to first render the sample water free by drying at a temperature of 110° to 120° C., as soils are dried for moisture determinations. Mr. J. O. Belz and the writer found, for example, that after ten times washing 50 grams of a coarse, clean sand containing 4.125 mg. of potassium nitrate, that the same sample oven dried after having been ten times washed in 100 c.c. of distilled water yielded when worked in the disulphonic acid a large additional amount of nitrates. Our actual figures are given below, where from 50 grams of sand we recovered:

By 1st washing of three minutes....	3.12100	mg.
" 2d " " " "32840	"
" 3d " " " "04515	"
" 4th " " " "01736	"
" 5th " " " "01380	"
" 6th " " " "01280	"
" 7th " " " "01109	"
" 8th " " " "01100	"
" 9th " " " "01100	"
" 10th " " " "01101	"
After drying.....	.76290	"
Total recovered.....	4.34551	"
Amount present	4.12500	"

These observations were made in February, 1902. Later in the season, in September, we made an examination of thirty-two samples of soil, representing eight soil types, determining the amounts of NO_3 , SO_4 , HPO_4 , HCO_3 , Cl and SiO_2 which could be recovered by washing 100 grams three minutes in 500 c.c. of distilled water as they came fresh from the field, and again by washing in the same manner 100 grams of the water free sample direct from the oven.

As an average of the thirty-two determinations of NO_3 , SO_4 , HPO_4 , and SiO_2 , made by Mr. Belz, and of the Cl and HCO_3 , made by Mr. A. T. Strahorn, it was found that from the oven dried samples we received 68.85 per cent. more NO_3 , 62.38 per cent. more HCO_3 , 62.42 per cent. more HPO_4 , 244.32 per cent. more SO_4 , and 287.9 per cent. more SiO_2 , than from the fresh field sample, but about the same amount of chlorine in each set of determinations.

This year, early in June, Dr. Schreiner and Mr. Ferris, of this Division, have shown by a less extended series of observations that the oven-dried samples yielded 54.15 per cent. more calcium and 109.03 per cent. more magnesia.

We were led to make these observations on account of the great difficulty in determining the true amount of nitrates in soil samples, on account of the rapid changes in nitrates which occur after a soil sample has been taken, the work being done to ascertain whether it would be admissible to render the samples water free to stop such action, and were surprised to find that we could recover from the oven-dried samples more readily water soluble salts of nearly every sort determined than we could recover from the fresh sample. The reasons for this increased amount are discussed in a section of the report of our results for 1902 not yet published. In this discussion we assigned several causes, but regard the physical conditions produced by the drying as the chief one. It appears to be demonstrated that the strength of the soil solutions in the water films surrounding the soil grains increases as the surface of the soil grain is approached, in an undetermined ratio; and when a moist field sample is put into distilled water and shaken for three minutes the films of water which the soil grains and granules possess under the field conditions move about in the solution with the soil grains, and during the three minutes of agitation, which we have adopted as our practicable limit, only a portion of the salts diffuse out into the surrounding water; but when the soil sample is rendered water free the readily water soluble salts are

deposited on the surface of the soil grains and the surface of the soil granules, so that when the distilled water is dashed upon them they go into solution; during the vigorous agitation, they are carried bodily away from the soil grains much more completely during the three minutes than is possible by the slower process of diffusion which must occur in the case of the moist sample, and on this account we recover a larger per cent. of the readily water-soluble salts which the soils carry.

There is still another physical condition which makes it possible to recover a large amount of readily water soluble salts by washing the oven-dried sample. In the first place the soil granules are more completely broken down by the pestling to which the samples are subjected after being oven-dried, so that the deposited salts are more freely exposed to the water when it is put upon the samples, and are dissolved more quickly on this account. Further, than this, while soil samples are drying in the oven the capillary action which is set up in the interior of the soil granules brings out upon their surface a considerable quantity of the salts, which in the moist condition are retained in the interior of the granules where the diffusion outward would be necessarily slower than if the granular condition did not exist and the salts were all in the water film surrounding the surface of the compound grain. This capillary action therefore which takes place during the time of drying, brings soluble salts where the water comes quickly in contact with them, even though the pestling does not completely break down the granular structure, which, as a matter of fact, it never does.

Large as are the amounts of readily water-soluble salts which we are recovering from our field samples, observations which we cite indicate that the amounts actually present are an undertermined amount greater than those we have found. As an example of the amounts of readily water-soluble salts which field soils carry, and as an illustration of the rapidity of securing results and the character of the results, the following table is given,

TABLE SHOWING THE AMOUNTS OF READILY WATER SOLUBLE SALTS FOUND IN THE JANESVILLE LOAM, NEAR JANESVILLE, WISCONSIN, MAY 1, 1903.

	K.	Ca.	Mg.	No ₃ .	HPO ₄ .	SO ₄ .	HCO ₃ .	Cl.	SiO ₂ .
<i>In parts per million of dry soil.</i>									
Surface Foot.									
Nothing added	28.72	138.00	42.28	36.32	37.60	222.50	64.00	2.00	35.11
5 tons per acre stable manure	27.70	120.00	43.90	28.56	43.00	240.00	40.00	2.00	62.86
10 " " " " "	26.80	127.50	38.90	34.56	82.00	187.50	60.00	2.00	55.72
15 " " " " "	18.08	135.00	39.36	32.64	27.80	210.00	54.00	2.00	41.75
300 pounds guano.....	26.20	114.00	38.44	25.96	26.20	215.00	28.00	6.00	27.94
Second Foot.									
Nothing added	48.80	96.00	34.24	46.88	18.40	178.00	6.00	2.00	68.14
5 tons per acre stable manure	24.16	100.00	36.42	24.24	19.00	185.00	12.00	2.00	68.75
10 " " " " "	31.52	66.00	36.04	28.56	34.80	162.50	22.00	2.00	63.78
15 " " " " "	27.84	86.00	32.64	28.00	24.40	200.00	22.00	2.00	28.13
300 pounds guano.....	28.72	94.00	34.24	23.44	8.60	200.00	24.00	2.00	36.43
Third Foot.									
Nothing added	13.36	56.25	33.94	45.44	29.40	215.00	6.00	2.00	36.28
5 tons per acre stable manure	41.92	57.00	30.58	26.72	31.60	182.50	22.00	2.00	35.10
10 " " " " "	15.76	60.00	27.40	28.00	34.00	162.50	22.00	2.00	72.94
15 " " " " "	25.68	72.00	30.84	25.96	9.80	197.50	42.00	2.00	47.03
300 pounds guano.....	34.88	61.00	33.64	13.52	34.40	187.50	22.00	2.00	42.68
Fourth Foot.									
Nothing added	27.84	53.00	33.28	42.72	17.20	195.00	12.00	2.00	26.38
5 tons per acre stable manure	26.01	51.00	26.34	30.88	72.40	190.00	14.00	2.00	39.27
10 " " " " "	29.12	57.00	26.74	26.40	56.40	160.00	12.00	2.00	87.53
15 " " " " "	28.40	58.00	25.18	25.04	28.40	167.50	12.00	2.00	56.34
300 pounds guano.....	18.56	55.00	30.58	20.16	80.60	215.00	14.00	2.00	25.80

illustrating a single day's work on a set of samples taken from the surface four feet.

It is not, of course, affirmed that the amounts of the different ingredients found in the soils examined are actually in solution in the soil moisture as the sample comes from the field, although in my judgment the observations indicate that this is likely to be the case for most of the ingredients at least, but observations sufficiently demonstrative have not yet been made to warrant such a statement as fact. The five sets of determinations in each group are, in a way, made on duplicate field samples; that is, they are taken at the same time from the same field but from alternating plots, one of which, as the table indicates, has received no treatment, the others having received the amounts of stable manure indicated, or the amount of guano. These samples were taken early in the spring, only a few days after the application of the stable manure and fertilizers.

Observations similiar to these are being carried through the growing season on eight types of soil in four different states, the samples being taken simultaneously in the four

different localities. All of the different fields are under the same crop conditions, so that any differences in yield may be determined for comparison with the amounts of soil moisture and the amounts of readily water-soluble salts which the soils upon which the crops are growing are found to contain. F. H. KING.

BUREAU OF SOILS.

July 30, 1903.

CURRENT NOTES ON METEOROLOGY.

PRELIMINARY METEOROLOGICAL OBSERVATIONS FROM THE 'DISCOVERY' EXPEDITION.

DR. H. R. MILL, in *Symons's Meteorological Magazine* for May, publishes some preliminary results of the meteorological observations taken on the British Antarctic Expedition near Mt. Erebus. The *Discovery* was in winter quarters in a sheltered position twenty-one miles from Mt. Erebus, in lat. 77° 49' S., long. 166° E. Among the observations three facts are of special interest by reason of their bearing upon the theory of the general circulation of the atmosphere, which is just now much in debate. Lieut. Royds, in charge of the meteorological observations, reports that

'northerly winds seem most prevalent during the summer months, and I do not think they were ever recorded in winter.' Another point concerns the direction of the upper currents, which was determined by watching the drift of the smoke from Mt. Erebus. It appeared, from these observations, that the upper winds were usually southwesterly or westerly, *i. e.*, they showed a marked tendency to blow out from the circumpolar region. A third characteristic phenomenon noted was the decided rise in temperature during southerly 'blizzards' in midwinter; a fall in temperature coming with a change in the wind direction to the eastward. As Dr. Mill points out, this rise in temperature should not be taken as an indication of higher temperatures farther south, but rather as a *föhn* effect, resulting from the mechanical warming of descending air currents.

SCINTILLATION OF STARS AND WEATHER CONDITIONS.

SOME attention has of late years been paid to the scintillation of the stars, especially from the point of view of the bearing of this scintillation upon the upper air currents. A recent study of these scintillations by Rosenthal, of the Central Observatory of St. Nicholas at St. Petersburg (*Meteorolog. Zeitsch.*, XX., 1893, 145-156), is directed towards the relation which these 'twinklings' have to weather conditions. As the basis for the investigation the writer takes the numbers (1 to 5) which indicate the quality of the seeing as noted in the observations of double stars through a refracting telescope at Domkino, 130 kilometers south of St. Petersburg, and at St. Petersburg. The observations were made on 142 evenings, from September, 1894, to November, 1900, and usually at about 9 o'clock. It appears that the least good seeing is noted on evenings with cyclonic conditions, while the best seeing is under neutral weather types. The relation of the seeing and the weather conditions has been so carefully determined by Rosenthal that he has been able to tabulate the probable seeing under a large number of different weather types at Domkino. It ap-

pears that the curve of the isobars is an important determining factor in this problem. The investigation is an interesting one, and is likely to lead to similar detailed studies elsewhere.

THUNDERSTORMS OVER MOUNTAINS AND LOWLANDS.

IN the *Meteorologische Zeitschrift* for May, Hegyfoky points out that his observations of thunderstorms, carried on for a number of years in Hungary, show an earlier occurrence in mountainous districts than over lowlands. In mountains the maximum hours of occurrence were 11 A.M.-2 P.M., while, over the lowlands the period of maximum was 2-5 P.M. The studies of Héjas, on the thunderstorms of 1871-1895, in Hungary, brought out similar facts.

R. DEC. WARD.

THE BRAIN OF PROFESSOR LABORDE.

PROFESSOR PAPILLAUT* has published preliminary notes on the brain of the late Professor Laborde, the eminent French physiologist and anthropologist. The brain-weight was low, 1,234 gms., but whether this was due to atrophy from old age (seventy-three years) or disease is not stated. Dr. Laborde's notable powers of speech led Papillault to examine the subfrontal gyres of the two sides with especial care, and he found that the area in question was demonstrably larger and more differentiated on the left side (where the motor speech-centers lie in right-handed persons) than on the right. The same feature characterized the brain of Gambetta. Unfortunately, Papillault makes no mention of the degree of development of the left insula as compared with the right, for it is this region which is most concerned with the association of the receptive and emissary centers of the cortex and so constitutes the true psychic speech-center.

Papillault adds that, in general, the convolutions show an average degree of complexity.

E. A. SPITZKA.

* *Rev. de l'Ecole d'Anthropol.*, 1903, p. 142.

RADIUM.

THE London *Times* publishes a report of a paper which M. Curie has communicated to the French Physical Society. It appears that at the time of his lecture at the Royal Institution in June, the resources of that laboratory in producing and manipulating liquid gases were utilized in a new series of experiments. Professor Dewar had already in 1893 improved the calorimetric use of liquid gases by means of a combination of vacuum vessels so that heat-evolution at the temperature of boiling liquid air or hydrogen could be determined with accuracy. When a sample of radium bromide weighing 0.7 gramme was tested in this way it was found to be capable of volatilizing an amount of liquid oxygen and hydrogen equivalent respectively to 6 c.c. and 73 c.c. of the gases measured at the ordinary temperature. It seems that through a very wide range of temperature the thermal emission remains unchanged. Whether at the temperature of a summer day or at that of liquid air, the emission of heat goes on without perceptible variation.

When, however, we make a long downward stride from liquid air to liquid hydrogen, radium shows that it is not always unaffected by external temperature. Within a comparatively short distance of the absolute zero a change occurs in the rate of heat-emission, but not in the direction that might be anticipated in view of the effect of low temperatures on ordinary chemical action. Instead of being reduced, the emission of heat, so far as present data can be relied on, is augmented at the temperature of liquid hydrogen. Whatever be the nature of this extraordinary phenomenon, it only increases in intensity at a point where all but the most powerful chemical affinities are in abeyance. The evaporation of a liquid gas gives an absolute measurement of the amount of heat given off by radium. Changes in the degree of radio-activity may escape the most careful observer, or may be imagined where they do not exist, but the quantity of liquid hydrogen which a given mass of radium converts into gas in a given time can be easily measured with an accuracy

which is beyond cavil, and the amount of heat required for the conversion can be ascertained with great precision. Hence there is no longer any doubt either of the quantity of heat evolved by radium or of the fact that the rate of emission is apparently greater in liquid hydrogen than at any temperature from that of liquid air up to that of an ordinary room. At the beginning of these experiments in liquid hydrogen a contrary result appeared to emerge when the low-temperature thermal measurements were compared with the early Curie values observed at the temperature of melting ice, as formerly given in *The Times*. This led to the curious discovery that a freshly prepared salt of radium has a comparatively feeble power of giving off heat at all temperatures, but that its power steadily increases with age until about a month from its preparation, when it reaches the *maximum* activity, which it afterwards maintains apparently indefinitely. A solution of a radium salt behaves in exactly the same way. Its power of heat-emission is at first relatively low, but goes on increasing for about a month, when it becomes equal to that of the solid salt, and so remains.

MAGNETIC WORK EXECUTED BY THE U. S.
COAST AND GEODETIC SURVEY BE-
TWEEN JULY 1, 1902, AND JUNE
30, 1903.

THE work accomplished during the fiscal year, July 1, 1902, and June 30, 1903, may be summarized as follows:

A. *Magnetic Survey Work.*—The magnetic elements were determined at 461 stations distributed over thirty-one states and territories, three foreign countries and adjacent seas. The principal work was done in Arizona (54 stations), Florida (26), Kansas (49), Louisiana (15), Maryland (8), Michigan (14), Nebraska (19), Ohio (19), Pennsylvania (52) and Texas (72).

By December of this year, owing to the progress already made, the magnetic survey of the area bounded by latitudes 35° and 41°, and longitudes 75° and 85°, embracing the states of Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, Ohio, North

Carolina and the eastern portions of Kentucky and Tennessee, will be completed and the results at once submitted to a careful discussion, with the view of ascertaining what improvements, if any, are needed in the methods of work, to bring out all of the practical and scientific purposes of a magnetic survey.

The work in Louisiana was done in cooperation with the State Geological Survey.

B. Ocean Survey Work.—In January, 1903, a Lloyd-Creek dip circle was mounted on the Coast and Geodetic Survey Steamer *Blake* and observations made on the trip to Porto Rico and return. Some compass work has also been done by the other vessels of the survey. The work has largely been of an experimental nature as yet. It has been demonstrated, however, that if the proper precautions are taken, valuable results may be secured. The Lloyd-Creek dip circle has been proved to be a most satisfactory instrument for both land and sea work.

C. Magnetic Observatory Work.—The four magnetic observatories situated at Cheltenham (Maryland), Baldwin (Kansas), Sitka (Alaska) and near Honolulu (Hawaiian Islands) have been in continuous operation throughout the year. Owing to various improvements being made in the vertical-force instrument, only the first-named observatory is provided with such an instrument, and, in fact, at this observatory a double set of photographic instruments are in operation (Adie pattern and Eschenhagen pattern).

In February, 1903, a temporary magnetic observatory was established in Fort Isabel, Bieques Island, Porto Rico, and since March registrations of declination and horizontal intensity have been secured.

D. Special Investigations.—A variety of special investigations have been made, embracing experimental work in the field and at the observatories and theoretical investigations at the office. Thus, for example, a preliminary examination was made of the locally disturbed region in the vicinity of Machinac straits, some magnetic observations having been made on the ice during the past winter, in addition to some shore observations.

E. Expeditions.—Besides the work of the survey proper, two expeditions have been fitted out with magnetic instruments and the observers given the necessary training and furnished with the requisite data and instructions; viz., the Zeigler North Polar Expedition, W. J. Peters being in charge of the magnetic work and the Bahama Expedition of the Baltimore Geographic Society, O. L. Fassig being in charge of the magnetic work.

F. Publications.—1. 'United States Magnetic Declination Tables for 1902, and Principal Facts Relating to the Earth's Magnetism.' By L. A. Bauer, Washington, 1902. (Special Publication of which a second edition is now passing through the press.)

2. 'The Magnetic Observatories of the United States Coast and Geodetic Survey in Operation on July 1, 1902.' By L. A. Bauer and J. A. Fleming. Appendix 5, Report of the Superintendent (O. H. Tittmann) of U. S. Coast and Geodetic Survey for 1902.

3. 'Magnetic Dip and Intensity Observations, January, 1897, to June 30, 1902, by D. L. Hazard.' Appendix 6, Report of the Superintendent (O. H. Tittmann) of the Coast and Geodetic Survey for 1902.

4. 'Results of International Magnetic Observations made during the Total Solar Eclipse of May 18, 1901, including Results obtained during Previous Total Solar Eclipses.' By L. A. Bauer. Published in *Terrestrial Magnetism*, December, 1902.

SCIENTIFIC NOTES AND NEWS.

DR. E. B. WILSON, professor of zoology at Columbia University, has been elected a member of the Accademia dei Lincei, Rome.

CAPTAIN R. E. PEARY has obtained three years' leave of absence from the Navy Department, with a view to conducting another Arctic expedition. It is reported that Mr. Morris K. Jesup is taking an interest in securing the funds required, which are estimated at from \$200,000 to \$250,000.

MR. ADOLF F. BANDELIER and Mrs. Bandelier arrived in New York on September 1, after an absence of eleven years in Peru and Bolivia. Mr. Bandelier was sent to South America by

the late Mr. Henry Villard to carry on archeological work, and was later in the employ of the American Museum of Natural History. The extensive archeological collections from Peru and Bolivia in the museum are largely the result of his industry.

DR. WILLIAM J. HOLLAND, director of the Carnegie Museum of Pittsburg, has returned to the United States with the important paleontological collections of Baron de Briet, the acquisition of which by the Carnegie Museum we were recently able to announce.

PROFESSOR HENRY F. OSBORN, of Columbia University and the American Museum of Natural History, has been visiting the camps in Wyoming and elsewhere, where paleontological excavations are in progress for the American Museum.

DR. ROBERT KOCH has secured further leave of absence in order to continue his work in Bulawayo until January next.

DR. W. G. TIGHT, president of the University of New Mexico, and Miss Annie Peck, with two Swiss guides, are reported by the daily papers to have ascended Mount Sorata in Bolivia, one of the highest peaks of the Andes, said not to have been hitherto ascended.

The American Geologist states that Dr. Ralph Arnold, assistant in geology at Stanford University, has been appointed assistant to Dr. Dall, of the U. S. Geological Survey.

DR. J. F. BIEHM has been appointed assistant bacteriologist in the Chicago Department of Health.

MR. S. R. BURCH, chief clerk of the Bureau of Animal Industry, has been appointed chief clerk of the Department of Agriculture, succeeding Mr. Andrew Geddes.

DR. WILLIAM A. WHITE, of the Binghamton State Hospital of New York, has been appointed superintendent of the Government Hospital for the Insane at Washington, succeeding the late Dr. Alonzo B. Richardson.

MR. R. FOX SYMONS has been appointed inspector general of health for the Transvaal.

THE Enno Sands prize medal for 1903 has been awarded by the Association of Medical

Surgeons of the United States to Major Frederick Smith of the British Royal Army Medical Corps.

A TABLET in honor of the eminent anatomist, Xavier Bichat, has been erected in the college at Nanthua which he attended.

PROFESSOR W. H. CORFIELD, who held the chair of hygiene in University College, London, and was well known for his contributions to sanitary subjects, died on August 26, at the age of fifty-nine years.

DR. SIMON SUBIC, associate professor of physics at the University of Gratz, died on July 27, at the age of seventy-three years.

THE Iron and Steel Institute of Great Britain, which closed its autumn meeting at Barrow-in-Furnace on September 3, has accepted an invitation to meet in the United States in the autumn of next year.

FOREIGN papers state that a resolution was passed at the conclusion of the recent geodetic congress at Amsterdam requesting the various nations to carry out extensive measurements of gravity from the Atlantic towards the east through the lowlands of Europe and Asia, as well as in the plateau around Thibet. A clear conception of the variations of weight and of the distribution of bulk in the crust of the earth would be gained thereby in connection with astronomical determinations of longitude and latitude.

THE Eleventh International Congress of Hygiene and Demography will be held at Brussels from September 2 to September 8, under the patronage of the King of the Belgians and the honorary presidency of Prince Albert. The president is Mr. M. E. Beco, general secretary of the ministry of agriculture; the general secretary, Dr. Felix Putzeys, professor in the medical faculty of the University of Liège.

DR. O. P. HAY has recently returned from a collecting trip in the Bridger deposits of southwestern Wyoming in the interests of the American Museum of Natural History. He spent there seven weeks, engaged especially in collecting fossil turtles, the others of the party being engaged in collecting remains of prim-

itive horses, monkeys and uintatheres. Altogether, there were secured over one hundred and thirty specimens of turtles. Some of these were more or less fragmentary, but there were found many complete shells and, in addition, seven skulls. These specimens will serve to throw light on the Eocene turtles, since many of the species were originally based on defective materials. Hitherto, skulls of the Bridger species have been almost wholly unknown. Of interesting genera whose skulls were obtained this summer may be mentioned *Baëna* and *Plastomenus*. The materials which were secured are to be employed in the preparation of a monograph of the fossil turtles of North America, for the Carnegie Institution.

THE expedition which left Seattle on June 30, on the Fish Commission steamer *Albatross* to investigate the salmon fisheries of Alaska is expected to return on the fifteenth of the present month. President David Starr Jordan, head of the commission, returned to Stanford University some time since. Among other members of Stanford University on the expedition were Messrs. C. H. Gilbert, Harold Heath, H. M. Spaulding and D. R. Rutter.

THE Canadian government steamer *Nep-tune* sailed on August 22 from Halifax for Hudson Bay and Arctic waters on an expedition lasting a year and a half with a view to botanical, geological and natural history investigations. The party will take formal possession of the Arctic Islands and the shore of Baffin's Bay.

It is announced that the relief ship *Frith-jof*, of the Swedish Antarctic Expedition, will be fitted with wireless telegraphy in order that it may remain in communication with gunboat *Uruguay* sent by the Argentine government. Baron Klinckowström accompanies the relief expedition as zoologist.

MR. ANDREW CARNEGIE has under the usual conditions offered to give £6,000 for a library building at Peterborough and £7,000 for a library building at Erith, Kent.

MR. EDWARD D. ADAMS has given to the American Museum of Natural History a specimen of radium, which has been placed on exhibition.

Nature states that a general exhibition arranged by the Central Association of Inventors, of Bayreuth, for the purpose of facilitating the sale of patents and copyrighted patterns is to be held during September and October next at Nürnberg. There are, it is stated, more than 200,000 copyrighted patterns in Germany and more than 140,000 patents, but one half of these are not in public use, the reason being that the inventors are not able to exploit their inventions. It was because of this that the Central Association came into being some years ago. Its purpose is to assist the members to make their inventions profitable to themselves, the majority of inventors not having the means to do so. The association furnishes space to inventors without means free of cost; and charges no fees for effecting a sale.

The British Medical Journal states that in the Germanic Museum at Nürnberg there has recently been placed a large medico-historical collection of medals. A considerable number of them were purchased at a sale held not long ago at Amsterdam.

ACCORDING to the *Journal of the American Medical Association* the Germans are planning to make an elaborate exhibit at the St. Louis Exposition of everything connected with medical instruction, especially in respect to diagnostics and therapeutics. Professor v. Bergmann is in charge of the matter, assisted by a committee, which includes Drs. Kutner, Kraus, Mikulicz, Orth, Rubner, Waldeyer, Wassermann and others, nearly all of Berlin. A circular inviting cooperation is to be sent forthwith to all the prominent institutes and firms throughout Germany.

A PRESS despatch from Simla, India, states that the Irrigation Commission has issued its report. It proposes to lay out \$150,000,000 in twenty years on protective works, and also \$2,000,000 annually in loans for private irrigation works, the necessary funds to be raised by loans, and the interest thereon to be charged to the famine grant.

ON the initiative of the director of the St. Petersburg Institute of Experimental Medi-

cine a Russian Microbiological Society is being organized.

SIR THOMAS HANBURY has purchased and presented to the Royal Horticultural Society the estate and garden of the late Mr. G. F. Wilson, F.R.S., at Wisley, near Woking.

WE quoted from the *London Times* some time since a statement that Sir William and Lady Huggins had contributed a paper to the Royal Society not then published containing the announcement of the discovery of lines of helium in the light emitted by radium. It was discovered subsequently that the lines were of nitrogen, and this result was added to the paper before publication. Sir Michael Foster thus explains the matter in the *London Times*. In mid July, during the recess, the Royal Society received (the officially recorded date is July 17) from the President, Sir W. Huggins, a short communication stating that by long exposure he had been able to obtain from the glow of radium at the ordinary temperature a photographic record of bright lines in the blue, violet and ultra-violet regions of the spectrum, and that several of these lines coincided with those of helium, but not with the most characteristic ones. A paper of such importance was sent at once to the society's printers with a view to its being published as early as possible. Within a few days, however, continued observations convinced Sir W. Huggins that the lines in question were those not of helium, but of nitrogen. Having arrived at this conclusion, he might have wished to withdraw the paper which he had sent in, replacing it by a wholly new one. He preferred to let the former paper stand as written, and to communicate the new results in the form of a dated addendum. The addition was printed as received on August 5, and the whole paper was published on August 15. In pursuing this course, the president followed the usual customs of the society, and, in my humble opinion, chose the better way, since a knowledge of the several steps through which an important result is reached is second only in value to the knowledge of the result itself. And, had the matter been confined within the publi-

cations of the society, nothing could have been said. But a friend of Sir W. Huggins, who saw the first part of the paper before it was officially received at the society, struck with its great importance, and knowing the willingness with which you, Sir, to the great benefit of the public, publish in your columns early notices of striking scientific discoveries, sent you a communication on the subject which you were good enough to print. 'Inquirer' complains that no similar communication concerning the notable addition to the first part of the paper has appeared. May I venture to point out that, in the absence of any organized arrangements, gaps, such as the above, in the scientific information which you publish are for one reason or another liable to occur without anybody being to blame?

SOME rare lizards have been deposited by Mr. Walter Rothschild, in the London Zoological Garden. According to the *London Times* his specimens of the Cuban anolis (*Anolis equestris*) are the first received alive in Great Britain, though the species has been known for nearly 200 years. Sir Hans Sloane was the first to describe it, from specimens obtained in Jamaica, and he compared it to a small iguana with a short comb or crest on the back, and a very long tail. The general color of the upper surface is bluish green, and of the under surface pale green—a color-scheme which is no doubt protective, and a later observer says that the reptile is scarcely distinguishable among the foliage of the trees on which it lives. The throat-pouch is of a deep pink, and, when inflated, gives the animal a very striking appearance. In the same cage is a chameleon lizard (*Chamaeleolis chamaeleontides*), from Cuba, also exhibited for the first time. As one would imagine, from the scientific names, there is a superficial resemblance to the chameleon; this is very strongly marked in the head and in the shagreen-like tubercles covering the body. The general hue is ashy brown, with rufous markings, and the throat-pouch is tinged with purple. The arrival of this specimen removes the doubt expressed by some writers as to whether the loose skin of

the throat could be inflated, for it is distended whenever the animal is excited. Late last year the scale-footed lizard (*Pygopus lepidopus*) was represented for the first time in the collection. Other specimens have recently been put out. In some respects these limbless lizards from the Australian region have a general resemblance to the British slow-worm, but the tail is exceedingly long and tapering, and the hind limbs are represented by two scale-like flaps of skin, closely adpressed to the side. These can be moved at will and contain the vestiges of the toe bones, which can be felt between the finger and thumb. In the sloths' house is an example of the Australian spiny anteater (*Echidna aculeata*), with the exception of the duck-billed platypus the lowliest of all mammals. It may be compared in appearance to a hedgehog, with long, strong spines and a beak-like snout about as long as that of the platypus, but tubular in shape. Its popular name is correct, so far as regards its food, which is obtained by the protrusion of the worm-like tongue, as is the case with the great anteater (*Myrmecophaga jubata*) of South America, examples of which are in the same house. There is, however, no close relationship, the former laying eggs, and having traces of a marsupial pouch, while the latter is a true mammal. Many authors reckon three species of spiny anteaters, according as there is more or less hair mixed with the spines, while others attribute this difference to the effect of the climate of Tasmania and New Guinea (where the more hairy forms occur) and claim that the examination of a large series of skins shows that the extremes grade into each other.

ENGLISH papers state that steps have been taken to begin immediately the construction of the section of the Cape-to-Cairo Railway between Wankie and the Zambesi at Victoria Falls and that 2,500 laborers will at once commence work on this section. Railhead will be at Wankie, about 200 miles northwest of Bulawayo, very shortly. With regard to other railways in Rhodesia, on the branch line between Bulawayo and Gwanda 31½ miles of rail have been laid of a total length of 104

miles. The Selukwe line will be finished at an early date, as the rails have already reached a point 16 miles from Gwelo and sufficient material is now on the spot for the completion of the branch. The removal of the light rails on the Vryburg-Mafeking section is rapidly proceeding, and, according to the latest advices, 42 miles out of the total 96 had been relaid with 60-pound rails.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Imperial Chinese University at Peking which abandoned its attempt to introduce European learning under the retrograde policy of the Dowager Empress has now been closed.

PROFESSOR J. MARK BALDWIN, of Princeton University, has been called to a new chair in philosophy and psychology in the Johns Hopkins University, where it is proposed to organize a university department in these subjects. Professor Baldwin will immediately enter upon his new duties, but it is expected that he will also give during the coming term certain senior and graduate courses at Princeton, where he may be addressed.

DR. E. W. SCRIPTURE, assistant professor of experimental psychology at Yale University, has resigned and is succeeded by Dr. Charles H. Judd, A.B. (Wesleyan), Ph.D. (Leipzig). Dr. Scripture is spending the year at Leipzig, where he is carrying on researches on the analysis of speech by means of gramophone records under the auspices of the Carnegie Institution.

DR. JOHN G. CURTIS, professor of physiology at the College of Physicians and Surgeons of Columbia University, has been elected acting dean of the college.

DR. AUGUSTUS POHLMAN has been appointed assistant professor of anatomy at the Johns Hopkins University.

AT Leland Stanford Junior University, Dr. Edward C. Franklin, of the University of Kansas, has been appointed associate professor of organic chemistry, and Dr. J. R. Slonaker, of the University of Chicago, has been appointed assistant professor of physiology.

M. LEBOEUF has been appointed professor of astronomy at the University of Besançon.